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ABSTRACT

Rather than being just the presentation of information, environmental education helps learners achieve environmental literacy, which has attitude and behavior components in addition to a knowledge component. This form of environmental education has its roots in nature study, conservation education, outdoor education, and the U.N. Tbilisi Declaration on the goals and principles of environmental education. Elements of effective environmental education programs: (1) are relevant to the mission of the agency or organization and to the educational objectives of the audience; (2) present ideas in ways that are relevant to learners; (3) involve stakeholders in all stages of the program; (4) empower learners with skills to address environmental issues and a sense of personal and civic responsibility; (5) are accurate and balanced, incorporating multiple perspectives and interdisciplinary aspects; (6) are instructionally sound, using "best practices" in education; and (7) are evaluated with appropriate tools. Important theories of learning, which can guide curriculum development and program planning, are Piaget's cognitive development theory, constructivism, multiple intelligences, and learning styles. Recommendations are offered for further research, discussion, and training related to the effects of environmental education on student learning and academic achievement and on environmental behavior change. (Contains 39 references.) (SV)

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"We can all continue to say we are only churchmen, or only educators, or only students, or only government people – that our role is limited, and that we cannot be expected to solve the problems of the world. But . . . some of us had better choose to define ourselves as world problem solvers if world problems are going to be solved" (Theobald, 1970).

Abstract – While said more than 30 years ago, the importance of this statement has not lessened. Amidst numerous, growing and complex environmental problems, the need for the preparation of world problem solvers is as great as ever (Wisconsin DPI, 1994). Environmental educators have globally accepted this role of preparing students to become critical thinkers, informed decision-makers and able communicators – a role that exceeds far beyond presenting information. Environmental education helps learners achieve environmental literacy, which has attitude and behavior components in addition to a knowledge component. Thus, the goal of environmental education is to instill in learners knowledge about the environment, positive attitudes toward the environment, competency in citizen action skills, and a sense of empowerment.

Environmental literacy depends on a personal commitment and motivation to help ensure environmental quality and quality of life. This commitment and motivation often begins with an awareness of one's immediate surroundings. Environmental educators can help foster learners' innate curiosity and enthusiasm, providing them with continuing opportunities to explore their environment and engaging them in direct discovery of the world around them. As learners develop and apply analysis and action skills, as they have the opportunity to make their own decisions and think more critically about their choices and as they hear stories of success, they are learning that what they do individually and in groups can make a difference. This locus of control, or sense that they have the ability to influence the outcome of a situation, is important in helping learners develop a sense of empowerment and a sense of personal responsibility – further key aspects of environmental education.

In order to reach this goal of environmental literacy, environmental education programs must be effective. Effective environmental education programs are relevant to the mission of the agency or organization, to the educational objectives of the audience, and to the everyday lives of the individual learners. They involve stakeholders in all stages of the program, from the development of the program to its evaluation. Effective programs empower learners with skills to help prevent and address environmental issues and with a sense of personal and civic responsibility. Further, they are accurate and balanced, incorporating multiple perspectives and interdisciplinary aspects. Effective environmental education programs are instructionally sound, using "best practices" in education. And finally, effective programs are evaluated with appropriate tools.

Background and Setting

Amidst numerous, growing and complex environmental problems, the need for the preparation of world problem solvers is as great as ever (Wisconsin DPI, 1994). Educators have globally accepted this role of preparing students to become critical thinkers, informed decision-makers and able communicators. In virtually every country "there is a frantic haste to develop programs in environmental education" (Wisconsin DPI, 1994, p. 10).

The roots of this environmental education movement extend back to the nature study movement, with leaders such as John Muir and Enos Mills and their study of the natural history of plants and animals. In 1891, Wilbur Jackman wrote *Nature Study for the Common Schools*, which aimed to educate urban dwellers who had lost touch with the natural world (Disinger, 1993). In 1896, a junior naturalist program associated with Cornell University taught students about the natural world in the context of understanding rural agriculture. In the early 1900s, Anna Comstock compiled the monthly newsletters from this junior naturalist program. The resulting book, *The Handbook of Nature Study*, was finished in 1911 and used for teaching natural history. The nature study movement contributed some of the early ideals for education that are still im-

portant today in elementary science education – inquiry and discovery with first-hand observation.

The conservation education movement began in response to the soil erosion, dust storms and flooding disasters of the 1930s. Initiated by resource management agencies, the goal of conservation education was to awaken Americans to the importance of conserving various natural resources. Forester Aldo Leopold gained national fame during this era and significantly influenced the movement through his passionate essays and provocative theories. Legislation was passed giving schools land designated for nature purposes. In addition, camps sponsored by churches and agencies, such as the YMCA, used recreation to help promote an understanding of the natural world. At the same time, the progressive education movement surfaced. Led by John Dewey, the focus of progressive education was "learning by doing," incorporating learning about the environment while in the environment (Disinger and Monroe, 1994).

The 1950s gave rise to outdoor education, with its sole specification of the place for learning – outside the school building. Outdoor education was described by L.B. Sharp, who wrote, "That which can best be learned inside the classroom should be learned there; and that which can best be learned through direct experience outside the classroom, in contact with native materials and life situations, should there be learned" (1947, p. 43). This movement was in response to concerns that urban youth were not experiencing direct contact with the natural environment. Teachers were encouraged to teach many different subjects in the outdoors, giving students this opportunity.

Through the nuclear testing of the 1950s and Rachel Carson's book, Silent Spring (1962), people began to notice the impact on the environment by "unseen forces," such as nuclear fallout and modern agricultural practices (Younger, 1995, p. 4). During the 1960s and into the early 1970s, the environmental movement contributed a human aspect to the evolution of environmental education, helping people realize the impact humans have on the natural and built environment. The 1970 Earth Day celebrations were "a landmark expression of public support for a realignment of values and a new respect for the environment" (Disinger and Monroe, 1994, p. 11). This set the stage for the transition of education *about* the environment and *in* the environment to education *for* the environment.

In 1972, the United Nations Conference on the Human Environment, held in Stockholm, Sweden, recommended the establishment of environmental education programs on an international level. Following this recommendation, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) sponsored a series of international environmental education workshops and conferences. United Nations representatives met in the former Yugoslavia in 1975 to define environmental education and establish its basic objectives. The Belgrade Charter was adopted at this conference, providing a widely accepted goal statement for environmental education (NAAEE, 1996). It states: "*The goal of environmental education is to develop a world population that is aware of, and concerned about, the total environment and its associated problems, and which has the knowledge, attitudes, skills, motivation, and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones*" (UNESCO-UNEP, 1976).

In 1977, representatives from 66 member nations and observers from two nonmember nations gathered for the world's first intergovernmental conference on environmental education. This conference, held in Tbilisi in the former Soviet Republic of Georgia, led to the release of an official statement on environmental education - the Tbilisi Declaration. Built on the Belgrade Charter, the Tbilisi Declaration acclaimed "the important role of environmental education in the preservation and improvement of the world's environment, as well as in the sound and balanced development of the world's communities" (Wisconsin DPI, 1994, p. 157).

In addition to establishing overall goals of environmental education, the Tbilisi Declaration established the following objectives of environmental education:

- *Awareness* – to acquire an awareness and sensitivity to the total environment and its allied problems;
- *Knowledge* – to gain a variety of experiences in and acquire a basic understanding of, the environment and its associated problems;
- *Attitudes* – to acquire a set of values and feelings of concern for the environment and motivation for actively participating in environmental improvement and protection;
- *Skills* – to acquire the skills for identifying and solving environmental problems; and
- *Participation* – to encourage citizens to be actively involved at all levels in working toward resolution of environmental problems (UNESCO, 1978).

The Tbilisi Declaration constitutes the framework, principles and guidelines for environmental education at all geographical levels – local through international – and for all age groups, both inside and outside the formal school system (Wisconsin DPI, 1994). The Belgrade Charter and the Tbilisi Declaration are con-

sidered founding documents of the field and provide the foundation for much of what has been done in the field since 1978 (NAAEE, 1996). More recently, the 1987 Brundtland Commission and the 1992 United Nations Conference on Environment and Development have influenced environmental education at an international level.

The passing of the National Environmental Education Act of 1970 in the United States reflected a national commitment to environmental education. This act stated that environmental education "is intended to promote among citizens the awareness and understanding of the environment, our relationship to it, and the concern and responsible action necessary to assure our survival and to improve the quality of life" (qtd. in Ford, 1981, p. 14). The 1990 National Environmental Education Act reaffirms the purpose of the earlier act. It also focuses on schools as the place for effective environmental education, while recognizing the importance of non-formal avenues for educating citizens, communities and the workforce (Disinger and Monroe, 1994).

In summary, environmental education is not the presentation of information. Environmental education helps learners achieve environmental literacy, which has attitude and behavior components in addition to a knowledge component. Thus, the goal of environmental education is to instill in learners knowledge about the environment, positive attitudes toward the environment, competency in citizen action skills, and a sense of empowerment (Disinger and Monroe, 1994). Further, while the audience is often youth, environmental education is intended for all – youth and adults, as well as individuals and organized groups.

Elements of Effective Environmental Education Programs

- Effective environmental education programs are relevant to the mission of the agency or organization, to the educational objectives of the audience, and to the everyday lives of the individual learners.

Good environmental education programs are relevant – relevant to the agency or organization, relevant to the audience and meaningful to their everyday lives. An agency or organization's mission and environmental priorities provide direction for program development in environmental education, guiding the development of goals and objects and their choice of target audience. Tying environmental education programs to the agency or organization's primary purpose helps focus program development and justify funding, prevent the establishment of generic environmental education programs, and aid in program efficiency and sustainability.

However, it is not enough for an agency or organization to consider only its mission or purpose. Environmental education programs are often distinguished from informative or interpretive programs, as they have objectives beyond information dispersal and involve working with an audience that often has pre-defined learning objectives. A school group, for example, has pre-defined learning objectives in the form of a curriculum – what teachers will teach, the order in which concepts should be covered, and expected knowledge and skills. A scout group would also have learning objectives, which might take the form of earning badges or patches. The key to relevant environmental education programs is finding commonalities among the existing learning objectives and the agencies or organization's mission and priorities. By doing so, the needs of both the provider (the agency or organization) and the audience are met. Teachers or leaders of the groups that will be participating in the program can often help find these commonalities by providing and explaining materials that offer learning objectives (state standards/benchmarks or badge requirements, for example).

Effective environmental education programs and materials need to present information and ideas in a way that is relevant to the learners (NAAEE, 1996). For example, a program on endangered species would be more relevant to students in Florida if the manatee were used as an example, rather than the Siberian tiger. This need for relevance stems from children's cognitive development, as they develop the ability to think concretely before they can think abstractly. When programs move beyond what is relevant and meaningful, learners don't have the chance to build their learning on what they already know - learning becomes too abstract.

Thus, content is more effectively conveyed when embedded in a local context, giving learners a chance to explore and experience what's around them. The sensitivity, knowledge and skills needed for this local connection provide a base for moving out into larger systems, broader issues and an expanding understanding of causes, connections and consequences (NAAEE, 1999). Likewise, skill building and application must be couched within the context of solving real problems – problems that directly affect learners either at home, at school or in their community. When environmental education is taught in the place where they live and through authentic situations, a learner's own experiences become a part of their education.

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Enjoyable learning experiences also help make programs more relevant to the learners. Many environmental educators realize the value of learners having direct contact with nature. Daniel Kriesberg, in *A Sense of Place*, writes, "They need to be outside. They need to explore, get dirty, find stuff – they need to have fun" (1999, p. xiv). The problem, explains Kriesberg, is that many learners don't have these opportunities. Small bits of wild places where kids can explore are disappearing and time to visit them becomes more and more rare, resulting in the "extinction of experience." Thus, environmental educators need to reintroduce learners to their local area by exploring and experiencing it, by learning about it and celebrating it. By doing so, environmental educators help learners develop a sense of wonder and a sense of place, fostering the awareness and appreciation that motivate them to further questioning, better understanding, and appropriate concern and action. (While enjoyable experiences in nature are one way to launch an environmental education program, it is not the only way. Learners in a central city environment, for example, may become interested in the environment through efforts to clean up a toxic waste site because it is damaging their water supply.)

- Effective environmental education programs involve stakeholders in all stages of the program, from the development of the program to its evaluation.

Successful programs bring a coalition of stakeholders together to design, implement and evaluate a program that meets their needs (Monroe, 1999). Stakeholders are those that have a stake in the program that is developed. They are they people who care about a program, are willing to develop a commitment to it and are best able to offer input into it. These stakeholders might be teachers, funders, agency supervisors, community leaders, landowners, extension workers, parents, and curriculum developers.

While it would be impractical to consult a large number of stakeholders on every decision, their input and participation is essential in the beginning stages (Monroe, 1999). Their participation lends a variety of perspectives to the program, shaping the program focus and audience. Their participation also helps achieve buy-in early in the process, so that as the program is developed, it is more likely to be used. Another advantage of using stakeholders is that it reinforces the image of community partnership and/or ownership and interest in the program. Stakeholders are also important during the evaluation phases of the program, as they can offer input about what information to gather, how to gather it and ultimately how to share it with important audiences.

While this stakeholder approach can seem cumbersome, most organizations using a stakeholder approach believe the strengths outweigh the extra time and effort needed to manage the process. Organizations using this approach have found several things helpful. In developing a team of stakeholders, think about who will be the ultimate users of the results and try to structure your team so that the results are channeled directly to those end-user groups. After identifying which groups should be represented on your team of stakeholders, select who, specifically, should represent each group on the team. Select team members who are enthusiastic, willing to represent his or her group, willing to commit to the project and those who have opinions but not "axes to grind." Strive for diversity among team members, not limiting members to those holding formal leadership positions within their groups or those that are the "most involved" or "best" (most involved teachers, for example).

Once a stakeholder team is established, communication is key. Responsibilities need to be clarified early and often through multiple modes of communication. Make sure your team knows they are acting in an advisory capacity and not in a decision-making capacity. Work with the team to identify rules and roles for smooth and effective operation. Group facilitation skills can also aid in effective stakeholder team operation. (Dr. Emmalou Norland at Ohio State University provided these guidelines to National Park Service employees utilizing the stakeholder approach in the development of education programs.)

- Effective environmental education programs empower learners with skills to help prevent and address environmental issues and with a sense of personal and civic responsibility.

Awareness and knowledge of environmental processes and systems play an important role in environmental education. But awareness and knowledge alone do not make a program an environmental education program. And when considering the goal of environmental education (environmental literacy and its accompanying responsible environmental behavior), research shows that knowledge and attitudes are not the only variables at play. While knowledge and attitudes alone don't help or harm the environment, human behaviors do. Behaviors, of course, are supported by knowledge and attitudes, but there is not a direct cause-and effect- progression from knowledge to attitude to behavior, as educators have long believed (Day, 1999).

How can educators help learners behave in environmentally responsible ways?

Some have turned to environmental communication techniques and social marketing theories to successfully address behavior change. School-based environmental education, however, differs from environmental communications and social marketing in that it doesn't always directly target specific behaviors, particularly in the context of controversial issues (Monroe, Day and Grieser, 2000). Instead, environmental education attempts to teach students "how to think" and not "what to think." Rather than directing learners in a specific course of behavior, environmental education helps learners form the capacity to collect and analyze information, make informed decisions, and participate fully in civic life (Monroe, Day and Grieser, 2000).

This requires more than the awareness and knowledge of environmental processes and systems and positive attitudes toward the environment; it requires procedural knowledge of how to affect change and the competency in citizen action skills needed to participate fully in civic life. Educators can help develop this procedural knowledge and competency in citizen action skills by providing opportunities to define an issue, determine if action is warranted, identify others involved in the issues, select appropriate action strategies, create and evaluate an action plan, implement the plan and evaluate the results (NAAEE, 1996). Educators can also provide opportunities to build skills in oral and written communication, conflict resolution, and leadership and opportunities to participate in the political or regulatory process, consumer action, and community service.

Thus, environmental education involves a learning progression from awareness to action, a progression mirrored in the objectives set forth by the Tbilisi Declaration described above. Environmental literacy depends on a personal commitment and motivation to help ensure environmental quality and quality of life (NAAEE, 1999). This commitment and motivation often begins with an awareness of one's immediate surroundings. Environmental educators can help foster learners' innate curiosity and enthusiasm, providing them with continuing opportunities to explore their environment and engaging them in direct discovery of the world around them (NAAEE, 1999). Furthermore, this learning progression is not necessarily linear nor is it hierarchical. As learners develop and apply analysis and action skills, as they have the opportunity to make their own decisions and think more critically about their choices and as they hear stories of success, they are learning that what they do individually and in groups can make a difference (NAAEE, 1999). This locus of control, or sense that they have the ability to influence the outcome of a situation, is important in helping learners develop a sense of empowerment and a sense of personal responsibility – further key aspects of environmental education.

- Effective environmental education programs are accurate and balanced, incorporating multiple perspectives and interdisciplinary aspects.

Environmental education has been criticized by a number of groups and individuals for lacking credibility and accuracy. A book by Michael Sanera and Jane Shaw, *Facts Not Fear: A Parent's Guide to Teaching Children About the Environment* (1996), has played a central role in this challenge. Children, according to this book, are being scared by misinformation presented by their teachers and textbooks. Katherine Kersten, chair of the Center of the American Experiment in Minneapolis, Minnesota, echoes this concern describing environmental education as resulting in a "we're all going to die" sense of hopelessness (in Menzies, 1997). Kersten states, "These days, facts frequently take a back seat in the environmental education . . . Too often environmental instruction seems to aim . . . at convincing children that the planet is in imminent danger, and they must save it" (qtd. in Menzies, 1997, p. 3).

In April 1997, the Independent Commission on Environmental Education released their assessment on environmental education materials, "Are We Building Environmental Literacy?" Sponsored by the George C. Marshall Institute, the Commission reviewed approximately 70 different resources for science and environmental education, including science textbooks and curricula produced by non-profit agencies, government agencies, and private individuals. This assessment, too, challenges the credibility of some environmental education materials, primarily with regard to the treatment of controversial issues.

In response to this wave of criticism, the National Environmental Education and Training Foundation (NEETF) prepared a briefing report. The report states, "Children and adults receive messages about the environment from many places – television, movies, books, newspapers, and magazines. The message may be about the environment, but Environmental Education, as practiced by concerned professionals, is very different from casual information or advocacy to promote a particular point of view" (1997, p. 1).

This report outlines the "facts" concerning environmental education. Environmental educators, according to this report, are advocates for balanced and scientifically accurate education. Guidelines estab-

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lished by the North American Association for Environmental Education (NAAEE, 1996) help ensure this balance and accuracy. The report cites characteristics for environmental education that are recommended by the NAAEE's *Environmental Education Materials: Guidelines for Excellence* (1996):

- factual accuracy – materials should reflect sound theories and well-documented facts;
- balanced presentation of differing viewpoints and theories – differences of opinion and competing scientific explanations should be presented in a balanced way; and
- openness to inquiry – materials should encourage students to explore different perspectives and form their own opinions (qtd. in NEETF, 1997, p. 2).

Their report further states that environmental education promotes quality education and effective teaching across the disciplines. Environmental education, according to the briefing report, can help schools accomplish the eight national education goals of the Educate America Act of 1994 (NEETF, 1997). The National Environmental Education and Training Foundation cites a report by the State Education and Environment Roundtable, in San Diego, California, which evaluated environmental education programs in 41 schools across 12 states. This report found environmental education programs increasing students' knowledge of the natural sciences, language arts, mathematics, and social sciences. In addition, over seventy-five percent of the schools evaluated reported increases in grade averages and standardized test scores (NEETF, 1997).

Pam Landers, project manager for the Environmental Education Teacher Preparation Project in Minnesota, has responded to the criticism surrounding environmental education in a similar manner, distinguishing environmental education from casual information and pure advocacy. Education, according to Landers, "should enable people to act intelligently, with some measure of independent thinking. People are not able to think and act intelligently "if they have been merely conditioned or coerced" (Landers, 1997, p. 5). Environmental education helps facilitate a student's ability "to make decisions, solve problems and conduct inquiries, using reading, communications, science, math and other skills as tools" (Landers, 1997, p. 5).

This recent opposition has prompted environmental educators to take a closer look at the validity, relevancy and accuracy of the field's materials and methods. The reports, books and newspaper articles challenging the credibility of environmental education are helping insure that the delivery of environmental education continues to be high quality education. While there generally is consensus in the field for this balanced approach prescribed by NAAEE, some environmental educators believe taking more of an advocacy approach is warranted when educating *for* the environment.

In some situations, it may be appropriate to take a less balanced, but still scientifically accurate approach. For example, it is appropriate for teachers to enforce socially accepted behaviors, such as no kicking or no cheating in class. By the same token, it may be justifiable for agencies to provide an unbalanced approach to socially accepted behaviors in areas such as boating safety, endangered species protection, and aquatic habitat improvement. But when educational messages drift to uncertain waters, such as pollution sources, private property rights or other controversial areas, agencies may be wise to avoid an advocacy message and instead revert to presenting multiple views and perspectives. Another example of when it may be appropriate to take a less balanced approach is when urgent and specific behavior change is needed or when the target audience is adults who have chosen to participate in the program. However, these situations perhaps may be viewed more accurately as using environmental communications or social marketing, rather than "true" environmental education.

- Effective environmental education programs are instructionally sound, using "best practices" in education.

According to the Wisconsin Department of Instruction, educational programs and curricula should be developed in response to theories of learning, such as Piaget's theory of cognitive development, constructivism, multiple intelligences, and learning styles (1994). In order for environmental education programs to be effective in an educational sense, they must also be congruent with the way people learn. The following are descriptions of theories of learning and their implications, which can guide curriculum planning, program development and methodology in environmental education.

Piaget's Cognitive Development Theory

Until about the 1930s, children were considered to be miniature adults intellectually; children differed from adults only in the quantity of knowledge they had acquired (Gormly and Brodzinsky, 1989). Through research by Piaget and others, it became clear that children think and learn in ways that are different from adults. As children develop, they reorganize and re-

construct their base of knowledge, replacing one set of assumptions with another.

Piaget identified four cognitive stages through which an individual may progress from birth through adolescence: sensorimotor, preoperational, concrete operation and formal operational. This sequence is invariantly ordered, and some refer to these stages, respectively, as the active child, the intuitive student, the practical student, and the reflective student. Development is associated with the passage from one stage of operation to another and is a function of experience and maturation (Joyce and Weil, 1996).

Piaget's theory implies that instructional methods and content need to be consistent with how students develop cognitively, as children cannot "learn" if they cannot understand what they are being asked to learn (Wisconsin DPI, 1994). Real knowledge, according to Piaget, can only occur when the task is useful to the student and when the student is psychologically ready (Joyce and Weil, 1996). Teaching, then, is the act of creating environments that allow for students' cognitive structures to change and emerge – environments that provide for learning opportunities at a level just above a student's current cognitive level. Many programs provide learners with choices, as learner tend to choose learning experiences appropriate for their cognitive structures. Applied to environmental education, curricula should be developed so that they facilitate stage-relevant thinking and allow students to discover for themselves the logical connections between object or events (Joyce and Weil, 1996). A further implication is for students to have many opportunities to explore the natural world and think about it within their various stages of intellectual development (Caine and Caine, 1990).

Constructivism

For most of this century, behaviorism has driven educational practice. This model of learning assumes that students are a blank slate on which the knowledge of others is simply written. Research since the mid-1970s has led to a new model – constructivism. Jean Piaget was an early supporter of constructivism, believing strongly that learning occurs as a result of dynamic interactions between individuals and physical and social environments (Wisconsin DPI, 1994). Thus, rather than being directly transmitted from teachers and books to students, knowledge is actively constructed from students actions in the environment (Wisconsin DPI, 1994). According to Piaget, the development of knowledge is a process of continual construction and reorganization (Yager, 1991).

Another key tenet of constructivism is the interplay between newly constructed knowledge and the learner's prior knowledge (Knapp, 1996). Ausubel et al. (1978) stated that the most important factor influencing learning is what the learner already knows. Learning occurs by "actively constructing knowledge, weighing new information against . . . previous understanding, thinking about and working through discrepancies . . . and coming to a new understanding" (O'Neil, 1992, p. 4). Learning can occur only when the new idea or concept can be integrated into the learner's existing conceptual system. Thus, the context of learning is important, as the situation must be both somewhat familiar and somewhat new. When the learner cannot integrate the new material with previous knowledge, rote learning occurs (McClelland, 1982).

For educators, constructivism implies that instructional methods need to be consistent with how students construct knowledge and that the context or content must be relevant. Clough and Wood-Robinson (1985) agree, arguing that classroom learning would be improved if teachers could build upon the learners' ideas rather than ignore them. Their research suggests that students "have a great deal of knowledge about a subject from out-of-school sources" (1985, p. 129). Teachers, according to this research, should draw preexisting knowledge into the classroom, using what learners already know and what is familiar to them as a basis for knowledge restructuring.

Anderson (1987) describes a three-stage process that can be used when teaching for conceptual change. In the first, or preparation, phase, learners "begin to think about the phenomena that will be explained in the unit, discuss their own explanations, and become aware of the limitations of their naïve explanations" (Anderson, 1987, p. 85). This stage is followed by a presentation phase, in which teachers explain key principles and theories. The final stage is application and integration. In this stage, learners apply the scientific principles to new phenomena and integrate those principles and theories into their personal knowledge.

These implications translate into elements useful to environmental education – programs that are learner-centered and involve active learning. In other words, environmental education is something students do, not something that is done to them. These aspects are at the heart of experiential education, a methodology that closely parallels constructivism. A central tenet of experiential education is that learning is an active process, occurring when experiences build upon previous experiences in a positive way and incorporate interaction between the learner and the environment (Anderson, 1987). Experiential education drives several specific instructional methods, including service learning,

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problem- or project-based learning, and field-based instruction. These methods are proving to be quite effective in environmental education and hold promise for motivating students and improving student learning and academic performance.

Constructivism also supports cooperative learning. Cooperative learning is a teaching strategy that allows learners to work in small groups to explore a new idea, gather information, discuss ideas, apply concepts and solve a problem (Monroe, 1999). Research has also shown that cooperative learning is an effective instructional approach for student achievement in reading, math, science and thinking skills (Lazarowitz and Karsenty, 1990; Slavin, 1994). Research by Solomon (1990), Nastasi and Clements (1991) and Lazarowitz and Karsenty (1990) has also shown that cooperative learning has positive effects on students' social skills and interactions with their peers. By incorporating cooperative learning into environmental education programs, students have the opportunity to gain communication skills, leadership skills and the ability to work with others – all of which are important aspects of environmental literacy (Monroe, 1999).

Gardner's Theory of Multiple Intelligences and McCarthy's Research on Learning Styles

Howard Gardner's theory outlines seven ways of recognizing a person's intellect. They are: visual-spatial, bodily-kinesthetic, musical, logical-mathematical, verbal-linguistic, interpersonal, and intrapersonal (Armstrong, 1994 qtd. in Knapp, 1996). According to Gardner, the main value of his theory is that it helps educators acknowledge differences in how students learn (Knapp, 1996). His theory of multiple intelligences is related to research on learning styles by McCarthy, who describes four major learning styles (1980).

One of the four learning styles is the imaginative learning style. Imaginative learners perceive information concretely and process it reflectively. Learning occurs through listening and sharing ideas, and the imaginative learner functions through social interaction. Analytic learners, the second type, perceive information abstractly and process it reflectively. An analytic learner prefers sequential thinking, need details and value what experts have to offer. The third type, common sense learners, perceives information abstractly and processes it actively. Common sense learners are practical and enjoy hands-on learning, looking for immediate use of what is being learned. Finally, dynamic learners perceive information concretely and process it actively. Dynamic learners learn by trial and error and self-discovery, being excited by anything that is new.

McCarthy's multiple learning styles research and Gardner's theory of multiple intelligences remind educators that not all students learn and respond to learning situations in the same way. Further, intelligence is not a fixed or static reality; it can be learned, taught and developed. Their research has important implications for those who develop and implement environmental education programs. The content, teaching methods and assessment used in an environmental education program should allow for the expression of multiple intelligences, allowing students multiple ways of learning and showing what they know and can do. Further, content should be presented using a variety of teaching strategies (groups, physical activity, artistic variations, etc.), providing students with the opportunities to express their learning styles and their auditory, visual, tactile and kinesthetic preferences for receiving information.

- Effective environmental education programs are evaluated with appropriate tools.

Program evaluation was born during the period of large-scale social programs and government intervention of the 1960s and 1970s (Patton, 1997). Program evaluation focused on guiding funding decisions, helping determine what was worth funding and what was worth doing. As evaluations were implemented, a new role emerged: increasing overall program effectiveness by guiding improvements to the program (Patton, 1997). Thus, today we think about program evaluation not only in terms of something that is done as or after a program is implemented (summative evaluation), but also as something that is done *throughout* the development and implementation of the program (formative evaluation).

In his book, *Utilization-Focused Evaluation*, Michael Patton provides a useful definition of program evaluation (1997). Patton describes this as the systematic collection of information about the activities, characteristics, and outcomes of programs to make judgments about the program, improve program effectiveness, and/or inform decisions about future programming. This type of evaluation is within contextual boundaries of time, place, values and politics. Central to his definition is meeting the information needs of specific intended users (the stakeholders). Their information needs, that is, their intended uses, focus the evaluation. Care must be taken to incorporate the stakeholders' opinions throughout the evaluation process, as this increases the likelihood that the findings will be used.

Another key aspect is the systematic collection of information about a potentially broad range of topics. Systematic data collection is emphasized as opposed to applying social science methods; program evaluators may use research methods to gather information but they may also use other forms of systematic information that are not research-oriented. While how to define program evaluation is a matter for discussion and negotiation, what is not negotiable is that the evaluation be data-based (Patton, 1997).

These two key aspects provide guidance for environmental education program evaluation. The evaluation should have a purpose and audience (how will the stakeholders use the findings?) and should involve systematic data collection. Determining the purpose for or the focus of the evaluation helps direct how the evaluation process proceeds, including what and how information is collected.

There are a number of tools or methods that can be used to collect information as the program is being developed. Comment or feedback forms, observations, interviews, focus groups, and surveys are examples. When curriculum materials are being developed, feedback by content and pedagogical experts should be a part of the development process. Individual lessons can be pilot tested or the program in its entirety can be field-tested, both of which are critical to developing practical and useful programs or curriculum materials. Information from these methods is used to help improve the program or materials. Information should also be collected after the program is complete to help the program manager make an overall judgment of the value of the program – often for the benefit of some external audience or decision maker. This information helps answer questions such as whether or not it worked, were goals met and should the program be continued.

For environmental educators, changes in knowledge, attitude, intentions, and behaviors of program participants are of interest. While important, designing an assessment to measure these changes is difficult. The questions must be specific enough to target some difference that will be measurable, and enough students must be involved to find significant differences. Further, to measure the impact of the program, one must be able to compare students who participated in the program with students who did not (experimental and control groups), or compare student's knowledge at two different times – before and after the program (pretest/posttest). The *National Park Education Programs: Making a Difference* report offers some suggestions: use both strategies of measuring impact (experimental/control groups and pretest/posttests) to reduce the problems associated with each; assign "equivalent" classes in the same school to be control and experimental; inform teachers of their role in the evaluation process; carefully select teachers and schools to provide a cross-section of reality in the school situation; and accept that there will be some factors that cannot be controlled (Monroe, Washburn, Goodale and Wright, 1997).

Recommendations for Further Research, Discussion and Training

- Research and/or Discussion Relating to Student Academic Achievement

As described in of the previous section, effective environmental education programs need to meet the needs of the audience. In the case of school-based environmental education programs, these needs relate to the educational objectives of schools at the classroom, district, state and national levels. While environmental educators realize the importance of environmental education and its relevance to the daily lives of students, they must also realize that school administrators may not believe it plays a highly relevant role in meeting students' educational needs and objectives. In the midst of school reform, standards and high stakes testing, environmental education may be the last thing on their minds. Thus, environmental educators find themselves having to justify environmental education (sometimes to their own agency or organization, as well as the schools). One way of doing this is demonstrating that environmental education can improve student learning and academic performance – the very goals that school administrators are seeking.

The Environmental Protection Agency acknowledges the need for research relating to environmental education and student learning. In a recent call for proposals (November, 2000), the Environmental Protection Agency is seeking to fund research projects that answer the following questions: To what extent does environmental education improve student academic performance when integrated within various core subjects (such as science, social studies, language arts, etc.)? What specific characteristics of an environmental education program and/or the instructional practices used have the greatest impact on student performance? What are the implications of this research for linking EE with state and national education reform efforts?

These research questions lead to questions for further discussion. Where do the goals of environmental education fit within this fairly recent emphasis on improving student learning? Or is environmental educa-

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tion "selling out" to meet the needs of the formal education community? Not necessarily. Environmental education has much to offer formal education, including a relevant context, engaging topics and "hands-on" opportunities for learning. When the goal of improving student learning is viewed as complementary with building environmental literacy, environmental educators can help the wider education community understand that environmental education is simply good education. This will go a long way in ensuring that, in the midst of education reform and its high-stakes standards and evaluation, environmental education doesn't get lost in the shuffle.

- Research and/or Discussion Relating to Education and Behavior Change

As described in Element C of the previous section, environmental education programs help build skills to prevent and address environmental issues. Preventing and addressing environmental issues brings us into the arena of behavior change and raises the question of how educators can affect behavior change using educational tools alone.

This relates to the long-believed notion that increased knowledge will lead to increased concern, which in turn leads to behavioral change. While knowledge, attitudes and behaviors are related, the relationship is not a simple cause-and-effect progression from knowledge to attitude to behavior, as educators have long believed (Hines, Hungerford and Tomera in Monroe, Day and Grieser, 2000). Further research has indicated that there are a number of variables acting in combination to influence behavioral intentions. Variables most closely correlated with environmentally responsible actions are perceived skill in using action strategies, level of environmental sensitivity, perceived knowledge of action strategies, and locus of control (Sivek and Hungerford, 1990).

A recent article in the Journal of Environmental Education takes this a step further. Researchers at the Seoul National University, Korea found that the variables of locus of control and attitude are more important than knowledge and personal responsibility in terms of the effects on intention to act. Specifically, the core variable "for improving the intention to act for responsible environmental behavior is internal locus of control" (Hwang, Kim and Jeng, 2000, p. 24). The article states further, "if environmental educators want to change or to improve their subjects' intentions to act, it would be effective to use programs and materials that can stimulate internal locus of control" (p. 24). The change of locus of control could be achieved by encouraging people to make their own decisions about problems and critically evaluate the opinions of others and by providing opportunities for people to apply action skills successfully (Newhouse, Hungerford and Volk in Hwang, Kim and Jeng, 2000). Despite these findings, this article still acknowledges that more research, specifically longitudinal, is needed as,"research has not yet satisfactorily identified the knowledge components that are the precursors to responsible environmental behavior" (Sivek and Hungerford in Hwang, Kim and Jeng, 2000, p. 20). This need concurs with a recommendation by Saunders, Hungerford and Volk (1992) for a national longitudinal study of changes in K-12 student behavior and behavior changes of target populations within the general public as a function of environmental education instruction and an investigation of the precursors to responsible environmental behavior within the general public (1992). Further, research has not yet identified how transferable or generalizable skills learned through environmental education are.

While these questions relating to behavior change provide opportunities for further research, they also provide the opportunity for further discussion – the consideration of how other disciplines might contribute to the goal of environmentally responsible behavior. The emerging discipline of social marketing, for example, provides some insight into these questions. Derived from commercial marketing and behavior psychology, social marketing can be used to encourage new behaviors in groups of people. To influence new behaviors, social marketing involves the following steps: identifying the audience and understanding what they perceive to be the barriers and benefits of their behavioral choices; designing a strategy that utilizes behavior change tools, piloting the strategy with a small segment of a community and finally, evaluating the impact of the program once it has been implemented across a community (McKenzie-Mohr and Smith, 1999). In contrast to environmental education's framework of building, knowledge, skills and attitudes to act on behalf of the environment, social marketing raises the possibility that people may change their behavior for motives other than environmental reasons.

Additional Recommendations for Further Research, Discussion and/or Training

1. *Addressing complex environmental issues through environmental education.*

The literature tells us the effective environmental education programs require content and methods that are concrete and relevant to learners. However, how do environmental educators handle the environmental issues that are not concrete and not immediately rele-

vant to the learners? Some have used case studies or success stories to help bridge this gap, making complex issues more relevant or concrete. More discussion and/or research are needed.

2. *Effectively using the stakeholder approach in program development and evaluation.*

The stakeholder approach is valued for reasons identified in Element B above. Multiple stakeholders often result in multiple interests, values and uses, which can sometimes lead to conflict. For example, a stakeholder team may have representatives from the agency, the school, and the community's primary industry and may strongly differ about the goals of the program being developed. Further training and discussion is needed to help those trying to use the stakeholder approach handle conflict among stakeholders.

3. *Professional development for teachers and non-formal educators.*

Although there are some good programs to train pre-service and in-service teachers in environmental education, these programs tend to be inconsistently available. Teachers often express misgivings about their ability to conduct environmental education programs and with outdoor classroom management. Further, many agencies and organizations that have environmental education as part of their missions, but lack the expertise among their staff to develop and implement effective education programs. Further discussion (followed by training measures) is needed to improve the quality and availability of professional development for pre-service and in-service teachers and for future non-formal environmental educators.

4. *Environmental Education and Education Reform.*

Environmental education has the potential to significantly improve the public education system. While initial studies are indicating that the goals of education reform (improved student learning, for example) can be effectively accomplished through environmental education, we do not know if environmental education is a *necessary* condition of improving education. For example, is using the environment as an integrating or motivating context better than using the arts (music, language, art) as the context? Determining that environmental education is indeed a necessary component of improved education can help establish its place in the curriculum, making it less subject to funding priority shifts and more likely to be a focus in teacher training.

1. *Reaching a broader audience.*

Most environmental education efforts target elementary and secondary students. As a result, important audiences – adults, people of color, low-income populations, senior citizens, and businesses, for example - are being missed or inadequately reached. Further research, discussion and training are needed in the area of knowing *how* to engage these audiences and how to adapt traditional teaching strategies to diverse communities and cultures.

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